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Do Chinese Exporters Still Need Learning Spillovers from Foreign MNEs?

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ABSTRACT

The study investigates learning spillovers from local firms as well as MNEs in China, and their indirect effects on other firms' exporting, paying particular attention to inter- and intra-industry spillovers. We develop a synthetic model based on the treatment of spillovers in economics, geography and international business, testing four different spillover effects, measured by export propensity and intensity of local Chinese firms associated with four types of export agglomeration. We find significant, positive spillovers effects. Surprisingly, spillovers transmitted from locally-owned exporters to local firms turn out to be stronger than those from foreign-owned exporters to local firms. Unsurprisingly, spillovers transmitted within the same industry are stronger than with different industries. The evidence suggests that after 30 years of openness to international trade and export-oriented development, China's indigenous firms have started to make a significant contribution to the export performance of other local firms. This finding is different from findings from previous empirical analysis, which reveals that maybe there's a diminishing **teaching effects** from foreign MNEs to local firms.

Keywords: learning spillovers, teaching effects, MNEs, indigenous firms

INTRODUCTION

A significant body of literature has developed on the export-enhancing role of inward foreign direct investment (FDI) for host countries. Ranked as the world's major recipient of FDI, an internationalized China is cited as an example of the success of a State policy of promoting inward investment. Besides attracting inward FDI, however, researchers (e.g. Buckley et al., 2007) and Chinese policy-makers have been aware of the indirect effects of investments by multinational enterprises (MNEs) on local firms, especially learning effects from MNEs. Thus, since 1978 China's central and provincial authorities have offered subsidies and other support over a long period to encourage MNEs to locate in particular agglomerations, particularly in special economic zones in coastal provinces. Such support has been heavily influenced by the research of geographers following Perroux's ideas on pôles de croissance, or growth poles (e.g. Boudeville, 1966).

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State of the literature

- We develop a synthetic model based on a Chinese-firms level database from more than 160000 manufacturing firms' observations, investigates learning spillovers from local firms as well as MNEs in China, and their indirect effects on other firms' exporting.
- We find significant, positive learning spillovers effects. Surprisingly, we find that spillovers transmitted from locally-owned exporters to local firms turn out to be stronger than those from foreign-owned exporters to local firms. Unsurprisingly, spillovers transmitted within the same industry are stronger than with different industries.
- The evidence suggests that after more than 3 decades of openness to international trade and export-oriented development, China's indigenous firms have started to make a significant contribution to the export performance of other local firms.

Contribution of this paper to the literature

- In contrast with most of the spillover literature concerned with productivity as a mediating variable between influences and outcomes, this empirical study was conducted in terms of export performance measured by export propensity and intensity of local Chinese firms associated with four types of export agglomeration.
- This finding is different from findings from previous empirical analysis, which reveals that maybe there's a diminishing teaching effects from foreign MNEs to local firms. On the other hand, our findings on the relative importance of foreign and local firms as sources of spillovers represent a major shift, with horizontal spillovers from local firms now the leading source.

Such developments may be crucial since substantial productivity spillovers may depend upon a large technology gap between local recipient firms and foreign investing firms, and therefore opportunities for "catching up" (Maye Sinani, 2009). In addition to this awareness of spillovers from foreign MNEs, it is argued here that an exclusive research focus on inward FDI and MNEs may divert attention from important interactions between locally-owned exporters, not necessarily in the same industry. The analysis of these spillovers has developed across three over-lapping disciplines, with this paper taking a synthetic view.

Within their firmly empirical tradition, geographers have cited an economist from the 1890s (Alfred Marshall) and his economies of "localized industry" as the inspiration for their distinction between localization (or agglomeration) externalities (or economies) and urban externalities, or economies (Chevassus-Lozza and Galliano, 2003). Localization economies (e.g. networks of suppliers, specialized labour and knowledge) relate to scale economies external to the firm but internal to the industry, i.e. interactions between firms within a particular industrial sector. As a recent development of this stream of research in the strategy literature, Porter (1996) has emphasized local competition between agglomerated firms as a driving force behind innovation.

On the other hand, urban externalities (e.g. knowledge diffusion within a region, infrastructural provisions, local government provisions, etc.) are external to both firm and industry and depend upon the size of a geographical agglomeration. A typical geographical study would refer to development poles or centers, and these externalities would be measured by location quotients that examine the local representation of a local activity compared with some national benchmark, often in terms of employment, or exports in the context of this paper (Becchetti and Rossi, 2000).

The economics spillover literature usually relies on Aggregate Production Functions (APFs) and the notion of profit-maximizing firms seeking and growing fastest in locations that maximize productivity and minimize costs, including external economies of scale (Haddad and Harrison, 1993; Romer, 1994). Spillovers are categorized as horizontal (intra-industry) spillovers and vertical (inter-industry) spillovers. Although most of this literature has exclusively considered intra-industry (horizontal) externalities (Kneller, 2007:106), the importance of inter-industry spillovers has been recognized in studies about R&D and productivity (e.g., Romeo, 1975; Glaeser, 1992; Scherer, 1982). Recent studies devote to finding evidence of FDI spillovers in terms of the diffusion of generic rather than industry specific technology. It is argued that MNE are keen to minimize the risk of propagation of specific technical knowledge to potential competitors and therefore intra-industry knowledge spillovers for host-country firms from

manufacturing activities by subsidiaries are unlikely. However, the absence of intra-industry FDI spillovers does not rule out the prevalence of inter-industry spillovers (Kugler, 2006).

Finally, an international business (IB) literature on spillovers has generally been based on a knowledge-based view (KBV) of the firm (Barney, 1991). The IB approach recognizes that higher productivity is not inevitable (Buckley et al., 2007) and may, in any case, may not always result in successful exporting. Here, the emphasis has been on information externalities rather than physical resource externalities. For example, with transport infrastructure as an urban/inter-industry spillover, the IB focus would be on the improvements in knowledge access that improve transport may bring in a region, rather than transport costs themselves and hence exporting. Such IB studies are mainly concerned with knowledge transfer through demonstration effects and linkage effects. This means that the spillover focus on IB has been extended beyond productivity to a consideration of the determinants of many strategic variables, e.g. innovation and exports. Although broader in terms of dependent variables, the IB emphasis has still been generally on MNEs as sources of spillovers, and has usually disregarded the inter/intra-industry spillover distinction. Wei and Liu (2006) provide an exception to this assertion in relation to inter/intra-industry spillovers, though they still employ the economist's APF approach in an IB journal, and still place an emphasis on MNEs.

In relation to exporters in particular, they may obtain knowledge of technologies and/or overseas market access from other exporters, either within or outside a particular industry (Wei and Liu, 2006). Even when employees or machines are physically transferred from one firm to another, however, the emphasis in IB studies is on the knowledge they may disseminate. IB researchers have borrowed liberally from the terminologies of geographers and economists, but they generally use the term spillovers, either across firms in general or within single industry, thus generally disregarding the vertical/horizontal terminology of economists, or the localization/urban economies of geographers. However, they are described, in China these spillovers may be enhanced by unique social networks and institutions.

Of course, spillovers can be negative as well as positive (Sun, 2009), and it is widely recognized that MNEs can compete with local firms for resources, possibly damaging their performance. In this case, what have been the conclusions from hundreds of empirical studies on spillovers across three disciplines – do positive or negative spillovers prevail?

Different studies have applied various techniques, involving location quotients, cross-sections, panels and longitudinal studies (Greenaway and Kneller, 2008). They have also addressed different variables representing firm performance, e.g. employment levels, productivity, technology or exporting itself. Leaving aside exporting for the moment, overall results have been mixed. In their survey of forty horizontal (intra-industry) spillover studies, Görg and Greenaway (2004) find that only twenty-two of these studies (using cross-section and panel data) report unambiguously positive and statistically significant externalities. Presumably, this mix of results reflects different methodologies, performance variables and the fact that different configurations of positive and negative spillover effects may occur in different institutional environments.

In the face of this burgeoning literature across three disciplines and somewhat mixed results, this paper concentrates on exporting activity directly, rather than productivity, and this implies a reliance on the KBV of the firm rather than APFs. The study focuses on China, a highly-internationalized country where spillovers may have been modified by personal networks and a narrowing technological gap (Mayer and Sinani, 2009). It extends earlier studies by considering exporting by local firms as well as MNEs, and their indirect effects on other firms, paying particular attention to whether they are industry-specific or have the characteristic of urban externalities or inter-industry, vertical spillovers. In this sense, it represents an extension of the KBV to cover exporting within the world's biggest internationalized country, with potentially important implications for Chinese policy-makers.

- Do positive export spillovers still prevail in an internationalized China?
- Are learning spillovers from MNEs still the most important in this respect?
- Is the industrial affiliation of linked firms still significant?

The next section addresses these research questions by reviewing the theoretical background to export spillovers, followed by sections dealing with hypotheses, methodology, results and conclusions.

EXPORT SPILLOVERS: DEFINITION AND CLASSIFICATION

While productivity studies of spillovers rely implicitly on profit-maximizing firms and cost minimization, recent IB studies have been extended to different enterprise strategies, including employment, innovation and, particularly, exporting decisions, with Aitken, Hanson and Harrison (1997) producing the seminal paper on export behaviour. They find that the operation of export oriented MNC subsidiaries in Mexico is associated with a higher propensity for domestic enterprises to enter foreign markets (Aitken et al., 1997). The finding highlights the potential positive effect on host-country manufacturing of the diffusion of MNCs' generic know how about how to export, including information on standards, market access and distribution channels.

The export spillover literature relates exporting in one firm to exporting in another (including indirect effects, i.e. spillovers) and does not usually address intervening variables such as backward or forward linkages between MNEs and their local suppliers and buyers, the training of local employees by MNEs and competition effects between foreign and local firms, productivity effects or non-exporting aspects of performance (Koenig, 2009). In other words, the firms is considered as a "black box", an issue addressed in our conclusions.

Increasingly, export spillovers may involve knowledge diffusion between host-country firms and other local firms (Wei and Liu, 2006). In addition, Javorcik (2004) emphasizes that diffusion between firms in different industries may be increasingly important: firms generating technological or exporting knowledge have an incentive to restrict information leakages to competitors, while firms have little incentive to prevent knowledge diffusion to linked industries. Hallin and Lind (2011) characterize horizontal spillovers as unintentional, as competitors imitate products through reverse engineering, etc. Vertical spillovers are more intentional on the part of source firms and therefore may deserve equally close attention.

Despite the best efforts of exporting firms to prevent unintended information leakage to other firms in the same industry, however, it has been assumed across the three literatures that intra-industry is stronger than inter-industry spillovers (Kneller and Pisu, 2007). For instance, same-industry firms can be sources of specialist and generic exporting knowledge (e.g. information about transport, foreign agents, currencies and markets) as well as generating the externalities that develop in a thriving agglomeration. Conversely, firms from different industries can only offer generic exporting knowledge and urban externalities, i.e. weaker spillovers (Kugler, 2006).

At the same time, with reference to both localized, intra-industry exporting knowledge and generic exporting knowledge across all industries, there are good reasons to suppose that export-oriented MNEs are more likely to be a source of export spillovers than host firms (Kneller and Pisu, 2007). This must be particularly true in the early stages of economic development, when Dunning's eclectic view would see MNEs from developed countries as possessing ownership advantages, attracted by the localization advantages of less-developed countries based on low-cost resources (Buck et al., 2007). Of course, on Dunning's view these countries may themselves eventually develop ownership advantages, thus increasing the importance of spillovers between domestic exporting firms.

Generally, empirical studies have supported these pre-suppositions in that same-industry exporters and MNEs have been found to be the most important source of export spillovers, though results vary depending on the country and time-period studied, and the export measure employed. Two quite different measures of export performance are distinguished in these studies (Filatotchev et al., 2009). First, export propensity as a zero/one variable that distinguishes exporting and non-exporting firms, and second, export intensity, representing exports as a proportion of total sales.

For example, an early study by (Aitken et al., 1997) using export propensity emphasized the importance of positive export spillovers in Mexico (1986-90), but with the emphasis on MNEs rather than local exporters. Similar results were reported by Clerides, Lach and Tybout (1998) for Columbia, Mexico and Morocco, by

Malmberg, Malmberg and Lundequist (2000) for Swaziland and by Greenaway, Nano and Wakelin (2004) and Kneller and Pisu (2007) for the U.K. On the other hand, Ruane & Sutherland (2004) found negligible or negative export spillovers for Ireland 1991-98, presumably because MNEs in Ireland in the 1990s had a negative competitive impact upon potential local exporters. Barrios, Görg and Strobl (2001) study export propensity and intensity in Spanish firms 1990-98 and find no evidence that firms benefit from spillovers via the presence of MNEs. Otherwise, however, positive spillovers flowing from MNEs have generally been reported.

Spillovers from local, host country exporters have been generally neglected in this literature, probably because they were downplayed in the seminal paper by Aitken, et al. (1997). However, Beccetti and Rossi (2000) did find that small-medium enterprises in Italian industrial districts did benefit from positive spillovers without the presence of MNEs, and regardless of industrial classification.

Generally, however, research has not conclusively addressed the intra/inter-industry nature of potential spillovers. In a developed country (Britain), Greenaway and Kneller (2008) found very weak export spillovers in terms of export propensity for firms in different industries. Similarly, Koenig, Mayneris and Poncet (2010) found insignificant spillovers in terms of export propensity between different industries in France, 1998-2003, and this result was repeated for the USA 1984-1992 by Bernard and Jensen (2004).

In the case of Vietnam, however, Anwar and Nguyen (2011) report that (p177), “the presence of foreign firms in Vietnam, through horizontal and forward linkages [*italics added*], significantly affects the decision of domestic firms to export as well as their export share.” In other words, they reinforce the importance of MNEs as sources of spillovers, but do question the dominance of inter-industry spillovers.

Studies of export spillovers in China have been rare, though a productivity study by Wei and Liu (2006) did find (p544) that “there are positive inter-industry productivity spillovers from R&D and exports, and positive intra- and inter-industry productivity spillovers from foreign presence to indigenous Chinese firms within regions.” However, when they focus on productivity in exporting firms, they go on to report (p554) that “...there coexist negative intra-industry export spillovers within and across regions and positive inter-industry export spillovers within regions”, attributing negative intra-industry spillovers to competition between MNEs and local firms within the same industry. However, using 1993-2000 data from China, Ma (2006) found that foreign firms from OECD countries (but not overseas Chinese firms) positively influenced exports by same-product local firms. As with studies outside China, therefore, the Chinese export spillover literature emphasizes, firstly, MNEs as sources of exporting knowledge and, secondly, the strength of horizontal spillovers (which may be positive or negative) and the relative insignificance of vertical, inter-industry spillovers.

With these theoretical deliberations and empirical results in mind, this paper proposes a contribution to the literature by avoiding productivity studies with a thorough investigation of export spillovers, measured as export propensity and intensity, in a Chinese economy where rapid progress through development stages has been achieved (Buck et al., 2007). Despite a literature that emphasizes the importance of MNEs and same-industry firms as sources of spillovers, this paper re-examines the evidence in China. The focus here is on the contribution of other local exporters as well as MNEs to spillovers, and whether intra- or inter-industry spillovers are stronger. Our hypotheses are developed from theory, supplemented by the results of earlier empirical studies.

HYPOTHESES

“The export activities of MNEs can certainly pave the way for local firms to enter the same export markets, because they can develop transport infrastructure and disseminate information about foreign markets and their needs, and Aitken, et al. (1997) conclude that (p. 104) “multinational enterprises are a natural conduit for information about foreign markets, foreign consumers and foreign technology and they provide channels through which domestic firms can distribute their goods”. Their activities can be observed and imitated by local firms and hence enhance their own export prospects. Being suppliers or subcontractors to foreign companies, local firms are able to enjoy spillovers through backward and forward linkages with foreign firms and upgrade their capabilities through collaboration (Barbosa and Eiriz, 2009). This could include strategic alliances, technology sharing

agreements, the mutual development of innovative products and practices, and cooperation on marketing and distribution contracts (Scott-Kennel, 2004). It can be seen, therefore, that MNEs can be sources of industry-specific information that may promote exporting (e.g. new product designs or production processes) and generic information. (For example, a German MNE can provide information about German and EU markets in general.)

In the case of China, numerous studies have supported the role of FDI via MNEs in facilitating international trade (Swenson, 2008; Wei and Liu, 2006). In China, one of the key themes of FDI policy was to allow export-oriented MNEs to invest in manufacturing sectors and help local firms to develop linkages with them and hence access foreign markets. It was not until the late 1990s that the export content requirement for foreign-owned firms was relaxed.

In relation to exporting, therefore, the attention of researchers and policy-makers has been focused on MNEs, and with an emphasis on horizontal knowledge diffusion, for good theoretical reasons: MNEs represent sources of industry-specific and generic information, and unintentional knowledge flows horizontally through labour transfer and other channels that facilitate imitation. This focus on MNEs and spillovers between firms in the same industry has often been vindicated by the results of empirical studies, presumably because foreign firms tend to produce a different product ranges to local firms, i.e. they may involve few negative spillovers via competitive effect or “crowding out” local firms (Meyer & Sinani, 2009). We therefore propose the following hypothesis:

H1: there are very strong, positive, horizontal export spillovers between foreign and local firms in the same industry and region.

In the literature on agglomeration economies, besides intra-sectoral externalities, it is argued that the diversity of local activity and knowledge generates cross-fertilization and improved firm performance (Wheeler and Mody, 1992). The industrial linkages literature indicates that firms in the same industry tend to benefit from neighboring firms (Aitken et al. 1997), but others argue that firms may be more tolerant of vertical knowledge diffusion to upstream and downstream firms than to their own-industry competitors (Javorcik, 2004). It is revealing that technological benefits to local firms through vertical linkages are much more likely than horizontal linkages since the multinational has incentives to provide technology to suppliers (Blalock, 2008; Kugler, 2006). Dunning (1998) observes that FDI has favoured spatial clusters of firms engaged in related activities in different industries, because mutual benefit occurs from shared access to localised support facilities, shared service centers, distribution networks, customized demand patterns and specialized factor inputs. In particular, a cluster of MNEs may attract more specialized service firms, such as repair and maintenance services, engineering and legal support, transportation and communication services, and financial and advertising services. Being close to foreign firms, local firms can enjoy the information externalities generated by foreign exporters but also physical resource benefits. The prevalence of a positive impact among other domestic producers in general due to the diffusion of generic technical knowledge spurred partly by linkage effects (Glaeser, 1992; Rodriguez-Clare, 1996). Still relying on the key spillover role of MNEs in theory, policy and empirical studies, we therefore propose:

H2: there are strong, positive, vertical export spillovers between foreign and local firms in different industries within the same region.

On the other hand, it can be argued within one industry that the spillover effects generated by MNEs may be limited, especially as firms from developing countries internationalize, become less dependent upon MNEs and even develop ownership advantages of their own. In addition, MNEs may successfully restrict the horizontal outflow of information to local firms as potential competitors. For example, Giroud (2007) investigated linkages between domestic and foreign firms in Malaysia and Vietnam and found that foreign firms succeeded in concealing their skills/technologies from local firms. Export-oriented MNEs may treat their local subsidiaries as production units, exclusively control foreign market access, limiting their exposure to other local firms (Buck et al., 2000). Furthermore, the interaction of foreign affiliates and host country firms might become less effective if local firms cannot adjust to the higher organizational and technological requirements of participation in their contractual arrangement with MNEs (Ostry and Gestrin, 1993; Siotis, 1999).

Table 1. Sources of spillovers and hypothesised interactions with local firms

Source of spillovers:		Spillovers to local firms:
Foreign-owned firms	Same industry	Positive, Very strong (H1)
	Different industry	Positive, Strong (H2)
Other locally-owned exporting firms	Same industry	Positive, Strong (H3)
	Different industry	Positive, Weak (H4)

In contrast, same-industry local exporters may become effective sources of industry-specific exporting knowledge. Local firms may benefit more from dense social network that facilitate frequent and unplanned fact-to-face contacts with other local exporters. An efficient system of formal and informal exchange of complementary information of complementary information can substitute for the lack of internal resources needed to overcome fixed information costs and to provide services necessary to enter foreign markets (Becchetti and Rossi, 2000). Second, tighter competition among local firms may improve product quality and thus allow them to win export sales in large segmented foreign markets, particularly in traditional sectors, characterized by horizontal product differentiation. In China, the government has for the last two decades promoted the agglomeration of labor-intensive export industries in economic zones, and industry clusters have formed. Local networks of same-industry exporters facilitate contractual relationships with other local exporters supplying MNEs, or with local firms with direct access to foreign markets, particularly where trade agents serve an industrial cluster of local exporters.

Therefore, while conceding that the balance of theory and empirical evidence suggests that “very strong” horizontal spillovers are only likely to continue to flow from MNEs, we argue for the emerging role of local exporters in an internationalized China as follows:

H3: there are strong, positive horizontal export spillovers between local firms and other local exporters in the same industry and region.

It seems unlikely that the “strong” relationship proposed for horizontal spillovers in H3 extends to vertical spillovers, particularly in relation to generic knowledge: local exporters are unlikely to be as strong as MNEs as sources of generic exporting knowledge. To repeat an earlier example, a German MNE may still be the best source of information about the German market. In the absence of inter-firm transactions, the efficiency gains related to the pool of labour may well be the only significant agglomeration advantage operative in such concentrations. These advantages may take the forms of efficiency gains due to a pooled market for workers and a varied set of input and service suppliers, benefiting a whole range of sectors (Egeraat, 2006).

Such urbanization economies (i.e., efficiencies that result from the agglomeration of many different kinds of activities in a given region) can be expected to play some positive spillover role and empirical studies support this conclusion. For example, Fan and Scott (2003) found that urbanization has a positive impact on the Chinese garments sector; Koenig, Mayneris and Poncet (2009) investigated urbanization economies in France and found that the greater the diversity of exported goods produced in the neighborhood, the greater the probability of exporting.

For these reasons, we propose that vertical spillovers between local firms in an internationalized China will still be positive, but weaker than for MNEs or same-industry local exporters:

H4: there are weak, positive vertical export spillovers between local firms and other local exporters in different industries within the same region.

These four hypotheses discussed above are summarized in [Table 1](#).

Table 2. Summary of variable definitions and measures

	All firms		Firms in non-natural resource-intensive sectors only	
	<i>EXPROP_{jki}</i>	<i>EXINT_{jki}</i>	<i>EXPROP_{jki}</i>	<i>EXITN_{jki}</i>
<i>feaggjk</i>	0.0004144***	0.0001334***	0.0004966***	0.0001677***
(H1)	(0.0000435)	(0.0000208)	(0.0000452)	(0.0000221)
<i>feaggjo</i>	0.000023***	7.50e-06***	0.0000242***	0.0000111***
(H2)	(1.53e-06)	(7.46e-07)	(1.98e-06)	(9.49e-07)
<i>eaggjk</i>	0.0011098***	0.0004088***	0.0007491***	0.00032***
(H3)	(0.0000366)	(0.0000198)	(0.0000388)	(0.0000193)
<i>eaggjo</i>	0.0000412***	8.97e-06***	0.0000532***	0.0000106***
(H4)	(1.18e-06)	(8.55e-07)	(1.44e-06)	(1.06e-06)
<i>aggj</i>	3.97e-05***	1.60e-05***	4.17e-05***	2.37e-05***
	(5.85e-05)	(3.43e-05)	(7.56e-05)	(4.36e-05)
<i>sizei</i>	0.1590489***	0.0037304***	0.1788085***	0.0040564***
	(0.0022255)	(0.0010725)	(0.0028711)	(0.0013077)
<i>sizei2</i>	-0.0003519***	-9.99e-06***	-0.0003884***	-9.87e-06***
	(7.32e-06)	(3.30e-06)	(8.65e-06)	(3.66e-06)
<i>lnfpfi</i>	-0.0685019***	-0.0586797***	-0.0815423***	-0.0576062***
	(0.0047812)	(0.0028039)	(0.0055348)	(0.003187)
Constant	-1.48843***	0.526487***	-1.323361***	0.5086615***
	(0.0263304)	(0.0320935)	(0.030226)	(0.0337319)
λ	0.2173984*** (0.0153641)		0.2385013*** (0.0171282)	
ρ	0.56683		0.60681	
Wald χ^2 (11)	6250.84	(Prob > χ^2 = 0.0000)	4684.52	(Prob > χ^2 = 0.0000)
Observation s	160533		116226	
Censored	131593		91425	
Uncensored	28940		24801	

MATERIAL AND METHODS

Data

The firm-level, cross-section data used in this paper were drawn from the Annual Report of Industrial Enterprise Statistics collected by the Chinese State Statistical Bureau (SSB) for 2007, a database containing the available accounts and related information for all state-owned enterprises and private industrial enterprises with sales over RMB5 million. The dataset covers all manufacturing firms in nine two-digit industries (Food Processing, Food Manufacturing, Beverage Production, Garments and other Fibre Products, Medical and Pharmaceutical Products, Machinery Manufacturing, Transport Equipment Manufacturing, Electric Machines and Apparatus, Electronic and Telecommunications Equipment). After checking for nonsense observations, outliers and incomplete data, a set of 207,738 firms including 160,533 locally-owned firms was adopted for further analysis. The data covers all 31 provincial regions. Descriptive statistics for the sample are presented in Appendix A.

We explain our dependent, independent, and control variables as follows. The definitions of the variables and their measurements are summarized in Table 2.

Dependent Variables

We use two dependent variables – propensity and intensity – to measure exports. Export propensity ($EXPROP_i$ for firm i) is unity if a firm exports a positive proportion of its output, and zero otherwise. Export intensity ($EXINT_i$) is a firm's ratio of export sales to total sales.

Independent Variables

Spillovers are represented by the numbers of exporting firms in each category (with their associated hypotheses):

feaggjk: the agglomeration of foreign-owned exporters in the same region j and industry (H1)

feaggjo: the agglomeration of foreign-owned exporters in the same region j but different industry (H2)

eaggjk: the agglomeration of locally-owned exporters in the same region j and industry (H3)

eaggjo: the agglomeration of locally-owned exporters in the same region j but different industry (H4)

Controls

Following previous studies on exporting, we include four control variables in our analysis. We use the ratio of employees in industrial enterprises/ area of the region (10,000 sq.km) - to measure the degree of overall agglomeration of industrial activity in one region (aggj). This controls for the possibility that general spillovers may arise from the general scale of the regional economy, rather than spillovers specifically from the agglomeration of exporters (Greenaway and Kneller, 2008; Levinsohn and Petrin, 2003). We also control for firm size (sizei), its quadratic term (size2) and total factor productivity (Intfpi). In recent heterogeneous firm models (Greenaway and Kneller, 2008), the decision to export is determined by a combination of sunk costs and firm specific productivity. As noted earlier, industrial or locational agglomeration might offer opportunities for lowering the sunk costs of exporting.

Methods

We use the two-step estimation method proposed by Heckman (1979) to test the four hypotheses, with the addition of partial elasticities. According to Heckman (1979), the model should incorporate two stages of the export process – first, the decision to export (i.e. propensity) and then the degree of exporting (i.e. intensity). This involves two equations, an export propensity equation (1) and an export intensity equation (2). The Mills ratio is introduced along with the other explanatory variables in an export propensity equation :

$$EXPROP_i = \sum \alpha Z_i + \varepsilon > 0 \quad (1)$$

This first step leads to estimates of $\hat{\alpha}$ and for each observation of the selected sample. We then compute the Mills ratio:

$$M = \frac{\varphi(\hat{\alpha}Z)}{\Phi(\hat{\alpha}Z)} \text{ if } EXPROP=1$$

where $\hat{\alpha}Z_i$ is the prediction of probit, φ and Φ are the standard normal distribution density function and distributed function, respectively. The export intensity equation is as follows:

$$E(EXINT_i | EXPROP_i = 1) = \sum \beta X_i + v \quad (2)$$

where $\varepsilon \sim (0, 1)$, $v \sim (0, \sigma^2)$, and $\rho = \text{corr}(\varepsilon, v)$. The distribution of the error terms (ε, v) is assumed to be bivariate normal with correlation. The two equations are related if $\rho \neq 0$.

With this framework, we develop an empirical model to test for associations, between each of the four types of spillover and the export propensity and intensity of Chinese local firms. The estimating equations (3) and (4) are as follows:

$$EXPROP_{jki} = \alpha + \beta_1 eagg_{jk} + \beta_2 eagg_{jo} + \beta_3 feagg_{jk} + \beta_4 feagg_{jo} + \beta_5 agg_j + \beta_6 size_i + \beta_7 size_i^2 + \beta_8 \ln tfp_i + \varepsilon_i \quad (3)$$

$$EXINT_{jki} = \alpha + \beta_1 eagg_{jk} + \beta_2 eagg_{jo} + \beta_3 feagg_{jk} + \beta_4 feagg_{jo} + \beta_5 agg_j + \beta_6 size_i + \beta_7 size_i^2 + \beta_8 \ln tfp_i + \gamma \lambda + \upsilon_i \quad (4)$$

Model Specification

We address the issues of possible reverse causality and simultaneity biases, as both (3) and (4) apparently suffer from endogeneity problems. For example, exporting may be affected by the local concentration of export activities on the one hand, and by spillovers from individual firm's export performance on the other. If the exporting of firm *i* depends on the exporting of neighboring firms, the latter is itself impacted by firm *i*'s export performance, which invokes a reverse causality problem. Further, simultaneity may be an issue, since unobserved supply-side or demand-side shocks could affect both the export performance of firm *i* and the performance of its neighbors (Mayneris et al., 2009). To overcome potential circularity and simultaneity, to provide more consistent estimates of coefficients and to identify causal relationships, we lag all the independent variables and control variables one year (Bernard and Jensen, 2004; Filatotchev et al., 2009; Leonidou and Katsikeas, 1996).

Further, we run the model with two different subsamples. First, we estimate (3) and (4) for the sample of locally-owned firms and exclude all firms defined as foreign-owned. Second, we rework the analysis for locally- and foreign-owned firms but exclude natural-resource-intensive industries. This is because the latter are tied to particular locations by resources rather than attracted by spillovers (Aitken et al., 1997). The results show that the coefficients of λ and ρ on all firms and non-natural-resources-intensive firms are positive and statistically significant, indicating the importance of sample selection and adaptation of the Heckman approach.

In addition, correlation matrix for the variables is presented in Appendix B. The correlation analysis of independent variables and four agglomeration variables shows a positive and significant relationship that is consistent with export agglomeration spillovers of.

To address concerns about multicollinearity, we report (Appendix C) the results of correlation parameters of explanatory variables that show that the correlation ratios are less than 0.2, suggesting no multicollinearity between explanatory variables that can therefore be used in the regressions.

RESULTS AND DISCUSSION

Regressions

Table 3 reports regressions for export propensity and intensity (Eqs 3 and 4) for all local firms (Cols 1 and 2), and for non-natural resource-intensive sectors only (Cols 3 and 4). It shows that the coefficients on all four spillovers variables are positive and significant, and to this limited extent they support our four hypotheses. Despite possible negative competitive effects, agglomerations of foreign or locally-owned exporters in China are associated with positive spillovers for local exporters, regardless of industrial classification. This outcome of positive and significant spillover coefficients is consistent with the majority of productivity studies (Greenaway and Kneller, 2007). However, there is one major difference between the sequencing of the coefficients and our hypotheses. The sequencing remains the same for all firms except that export spillover coefficients for local firms in the same industry ($eagg_{jk}$: H3) are the strongest. In modern China, there seems to have been an important shift from foreign to local firms in the generation of export spillovers. Stronger tests of our four hypotheses are discussed at 5.2 below, and in this section 5.1 we focus on the regressions and in particular, our four control variables.

Table 3. Estimates of export spillovers

	All firms		Firms in non-natural resource-intensive sectors only	
	<i>EXPROPjki</i>	<i>EXINTjki</i>	<i>EXPROPjki</i>	<i>EXITNjki</i>
<i>feaggjk</i>	0.0004144***	0.0001334***	0.0004966***	0.0001677***
(H1)	(0.0000435)	(0.0000208)	(0.0000452)	(0.0000221)
<i>feaggjo</i>	0.000023***	7.50e-06***	0.0000242***	0.0000111***
(H2)	(1.53e-06)	(7.46e-07)	(1.98e-06)	(9.49e-07)
<i>eaggjk</i>	0.0011098***	0.0004088***	0.0007491***	0.00032***
(H3)	(0.0000366)	(0.0000198)	(0.0000388)	(0.0000193)
<i>eaggjo</i>	0.0000412***	8.97e-06***	0.0000532***	0.0000106***
(H4)	(1.18e-06)	(8.55e-07)	(1.44e-06)	(1.06e-06)
<i>aggj</i>	3.97e-05***	1.60e-05***	4.17e-05***	2.37e-05***
	(5.85e-05)	(3.43e-05)	(7.56e-05)	(4.36e-05)
<i>sizei</i>	0.1590489***	0.0037304***	0.1788085***	0.0040564***
	(0.0022255)	(0.0010725)	(0.0028711)	(0.0013077)
<i>sizei2</i>	-0.0003519***	-9.99e-06***	-0.0003884***	-9.87e-06***
	(7.32e-06)	(3.30e-06)	(8.65e-06)	(3.66e-06)
<i>Intfpi</i>	-0.0685019***	-0.0586797***	-0.0815423***	-0.0576062***
	(0.0047812)	(0.0028039)	(0.0055348)	(0.003187)
Constant	-1.48843***	0.526487***	-1.323361***	0.5086615***
	(0.0263304)	(0.0320935)	(0.030226)	(0.0337319)
λ	0.2173984*** (0.0153641)		0.2385013*** (0.0171282)	
ρ	0.56683		0.60681	
Wald χ^2 (11)	6250.84 (Prob > χ^2 = 0.0000)		4684.52 (Prob > χ^2 = 0.0000)	
Observations	160533		116226	
Censored	131593		91425	
Uncensored	28940		24801	

Note: t-statistics are in parenthesis. *** Significant level at 1%; **significant level at 5%; * Significant level at 10%

Our results for positive export spillovers remain significant, regardless of the scale of the regional economy measure in terms of employees (*aggj*). This control variable is also positive and significant in relation to the export propensity and intensity of local firms, presumably because it proxies for geographic location, natural resource endowments and for local institutions, e.g. incentives offered within the special economic zones.

Our second and third controls relate to the size of firms (*sizeijk*) in terms of employment relative to total industry employment and (*sizeijk*)². Studies (Greenaway and Kneller, 2007) generally report that exporters tend to be larger.

However, we find that there is a U-shaped relationship between firm size and exporting. This may reflect two competing effects: economies of scale may help firms to reduce production costs and therefore enhancing export competitiveness; on the other hand, large firms may enjoy significant profits from serving a large and growing domestic market, and thus have fewer incentives to export and export intensively.

Finally, we find a negative coefficient between total factor productivity (*Intfpijk*) and exporting. It may imply that export behavior may not necessarily induced by productivity changes. The result is consistent with findings by Wei and Liu (2006) that, by employing the economist's APF approach, there coexist negative intra-industry export spillovers within and across regions and positive inter-industry export spillovers within regions. They attribute the negative intra-industry spillovers to the intense competition for exports between foreign-invested and local Chinese firms in the same industries.

Table 4. Spillover effects: semi-elasticities

	All firms		Firms in non-natural resource-intensive sectors only	
	<i>EXPROPjki</i>	<i>EXINTjki</i>	<i>EXPROPjki</i>	<i>EXITNjki</i>
<i>feaggjk</i> (H1)	0.0639%	0.0116%	0.071%	0.0134%
<i>feaggjo</i> (H2)	0.0035%	5.74E-05%	0.003%	0.0001%
<i>eaggjk</i> (H3)	0.1712%	0.041%	0.108%	0.032%
<i>eaggjo</i> (H4)	0.0063%	0.0009%	0.007%	0.001%

Semi-Elasticities

Section 5.1 and [Table 3](#) address our spillovers regressions and provide some support for our four hypotheses in the sense that all spillovers coefficients are significantly positive, but do not provide conclusive tests. Contrary to the sequencing of the four hypotheses in terms of the strength of different export spillovers, for all firms, they show coefficients for same-industry local firms (*eaggjk*: H3) as the strongest source. However, estimation of the relative strengths of different spillovers is more properly conducted using semi-elasticities.

[Table 4](#) presents our estimations and seriously challenge the hypothesized strength of different export spillovers in an internationalized China. As with the regressions themselves earlier, the semi-elasticities show a similar picture, where same-industry local firms (*eaggjk*: H3) for all four samples are the strongest source of export spillovers, contrary to H3 and H1, which proposed same-industry foreign firms as the strongest source. For example, for all firms, one additional locally owned exporter in the region is associated with a significant increase in the probability that another local firm exports by 0.171% (0.064%), and an increase in export intensity of 0.041% (0.012%), where the figures in parentheses represent comparative figures for same-industry foreign firms. This downgrading in the importance of foreign firms as sources of export spillovers is also reflected in the semi-elasticities for all firms in different industries: an additional local (foreign) exporter is associated with an 0.006% (0.004%) increase in the probability of another local firm exporting and an 0.001% (5.74E-05%) increase in export intensity. It may be noted that these rankings emerge from three of the four samples of firms. The spillovers influence of foreign firms is clearly lower than hypothesized. As hypothesized, vertical spillovers are weaker than horizontal (same industry) interactions for foreign and local firms in each of our four samples. However, it should be noted that vertical spillovers from local firms are stronger than from foreign firms. Despite the relative weakness of vertical compared with horizontal spillovers, it should not be forgotten that they are still positive and significant in each sample. Industry-specific knowledge is still not totally dominant in the generation of spillovers. This is consistent with observations that MNEs optimally engage in exclusive supplier contracts in the case of specific input to avoid intra-industry FDI spillovers due to strategic considerations (Kugler, 2006).

We may tentatively suggest possible interpretations of these results. For example, weaker spillovers from foreign firms may be the consequence of a narrower technology gap after internationalization, and foreign firms may now compete more directly with local exporters. Looking at local firms, local information networks for local Chinese exporters may now be more important sources of exporting knowledge than foreign firms. Wang (2001) observed that a club culture has emerged in the cities and towns of Zhejiang province which further stimulates interaction among entrepreneurs, managers, engineers, and professionals and promotes a climate of entrepreneurship, innovation, exporting and risk taking. They view social relationships as crucial resources for their businesses; informal, face-to-face interactions served as an important source of up-to-date information about competitors, customers, markets, and technologies.

CONCLUSION

How do we respond to the research questions posed at the end of our first section? This paper reveals that maybe there's a diminishing teaching effects from foreign MNEs to local firms. In contrast with most of the spillover literature concerned with productivity as a mediating variable between influences and outcomes, this empirical

study was conducted in terms of export performance. With the promotion of exporting as a prominent strand of state policy, such an approach seems sensible,

It would appear that export spillovers are still positive and prevalent in an internationalized China, with but with significant changes. However, one of our findings represents no major change from the existing literature: horizontal (same-industry) spillovers are still dominant, even though vertical spillovers remain positive and significant.

On the other hand, our findings on the relative importance of foreign and local firms as sources of spillovers represent a major shift, with horizontal spillovers from local firms now the leading source. It would appear that thirty years of increased openness to international trade has brought a degree of maturity to local Chinese exporting firms, making them a more important source of exporting knowledge than MNEs. China's indigenous firms have grown rapidly and are making a significant contribution to export performance, and their export activities are positively associated with higher export propensity and intensity in neighboring firms. This brings into question the possible need for a more balanced foreign trade policy between foreign investors and indigenous firms in China. With the greater spillover effects from local exporters' agglomerations, more attention may be paid to providing them with a fairer business environment by reducing the favored treatment of foreign-owned firms?

Policy Relevance

It is always impertinent for academics to preach the managerial relevance of their studies, when they are based on the analysis of managerial decisions in the past. In this paper, export spillovers were detected precisely because indigenous Chinese firms have grown faster in exporting terms when in the proximity of other Chinese exporters in a similar industry. For example, they may have obtained knowledge of exporting techniques through demonstration effects, and/or staff with knowledge of exporting may have been poached from similar indigenous firms. Firms knew exactly what they were doing by taking advantage of exporting knowledge in local indigenous firms.

Where such proximity occurred spontaneously and unconsciously, however, it may be relevant for academics to draw the attention of practitioners to the patterns they have observed. Certainly, potential Chinese exporters need not be concerned with a strategy of the past, which involved orientating their location decisions around the location of foreign MNEs.

Further relevance for managers may arise indirectly through the actions of policy-makers. This paper suggests that exporting may benefit from the geographical clustering of indigenous Chinese exporters in similar industries, and this may justify state policies that encourage such clustering, or development poles. This need not involve locational controls or subsidies, and could be limited to infrastructural provisions that are relevant to certain industries. For example rail provision or deep-port facilities could benefit clusters of firms in a bulk-chemical industry.

Limitations and Further Research

Of course an important limitation on our study was its focus on one cross-section of Chinese data for 2007, and this raises questions concerning the generalizability of our results over different periods and countries. Will continued economic development produce further longitudinal increases in export spillovers from local firms? Do theories constructed in the developed west need to be modified for a country like China, with its formal and informal institutions still in transition?

An important limitation of our study is that it has not looked inside the "black box" of the firm, but that may be the source of export spillovers. China still possesses unique, well-developed, managerial social networks that undoubtedly influence spillovers. Subsequent longitudinal research may reveal whether China's transition and networking have produced temporary anomalies in terms of established theory, or whether new theories are

needed to reflect permanent new configurations of local institutions in transition economies (Wright et al., 2005). Further research may usefully address other Asian economies with similar informal institutions to China to check for the robustness of findings on export spillovers from local firms.

Above all, however, research needs to address the possibility that the joint ventures and subsidiaries of foreign MNEs are no longer as embedded as indigenous exporters in Chinese industry clusters (Birkinshaw, 2000). MNEs may not have the freedom to source from local suppliers, being part of MNEs' international networks rather than local ones, and it seems likely that indigenous Chinese exporters are now developing strong linkages with other supplying and competing firms in their industry. The task for future research is to identify these stronger ties directly.

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